Cryptography and Network Security

Introduction to Advanced Encryption Standard (AES)

Outcomes

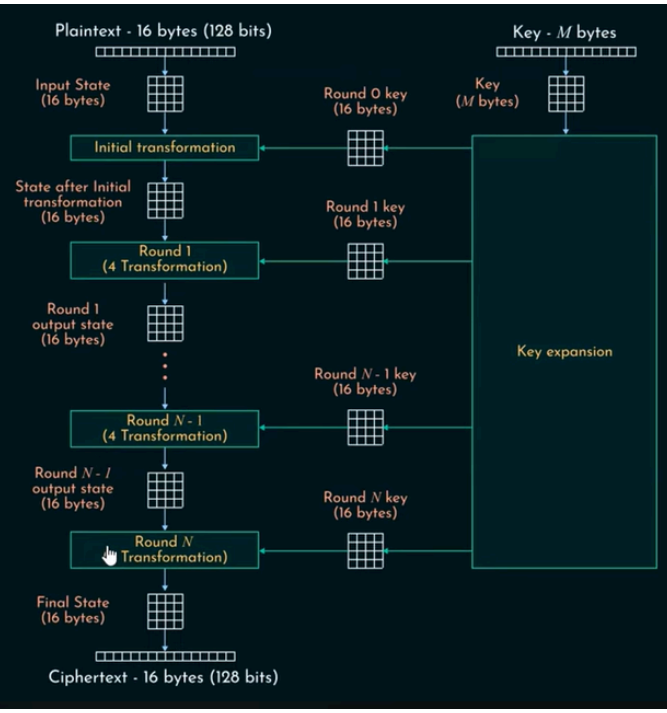
Upon the completion of this session, the learner will be able to

- ★ Understand the basics of AES.
- ★ Know the basic differences between DES and AES.
- ★ Know the AES structure.
- ★ Know the AES parameters.

AES

- Advanced Encryption Standard.
- NIST in 2001.
- Symmetric block cipher.
- Widely used.

AES Structure



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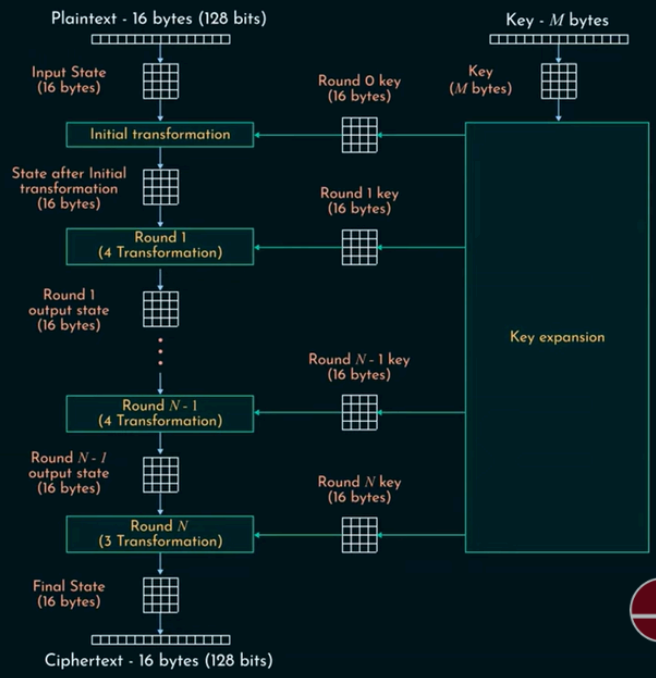
AES Structure

No. of rounds	Key size (in bits)
10	128
12	192
14	256



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AES Parameters

	AES-128	AES-192	AES-256
Key Size	128	192	256
Plaintext Size	128	128	128
Number of rounds	10	12	14
Round Key Size	128	128	128

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AES Encryption and Decryption

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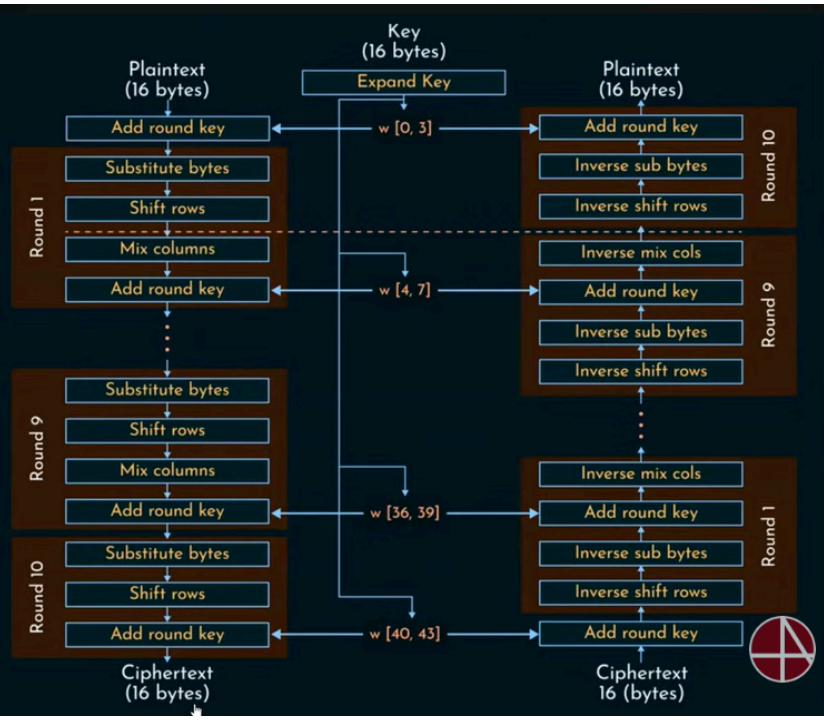
Outcomes

Upon the completion of this session, the learner will be able to

- ★ Recall the AES structure and the relationship between the key size and number of rounds.
- ★ Understand the AES encryption and decryption.
- ★ Know the various transformations in AES encryption and decryption process.

AES Encryption and Decryption



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AES Round Transformation

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Outcomes

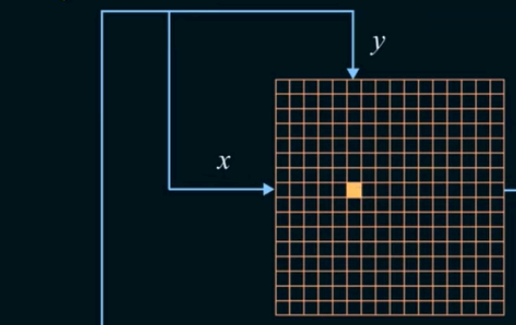
Upon the completion of this session, the learner will be able to

- ★ Understand the four transformations in AES encryption and decryption process.

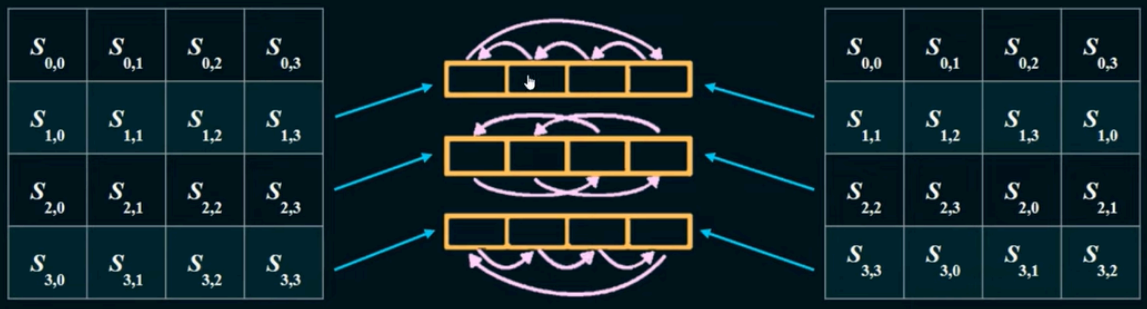
AES Transformation Functions

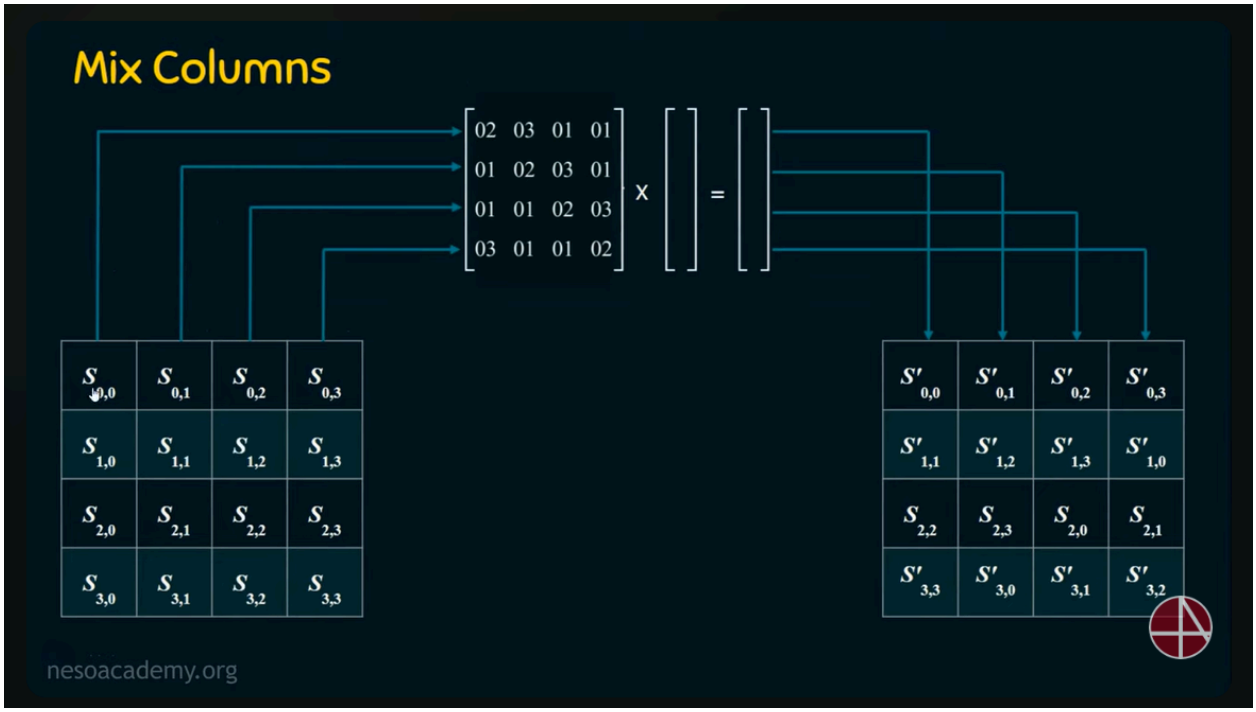
- ★ Substitute Bytes
- ★ Shift Rows
- ★ Mix Columns
- ★ Add Round Key

Substitute Bytes



Shift Rows




Mix Columns
02 03 01 01
01 02 03 01
01 01 02 03
03 01 01 02
x
=
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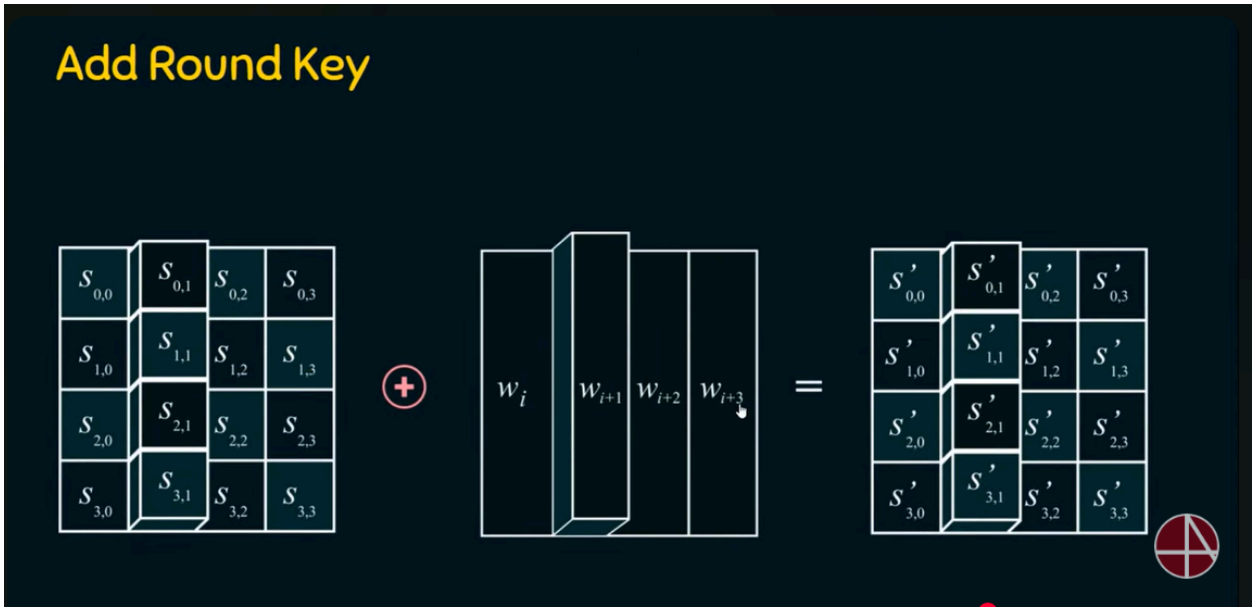
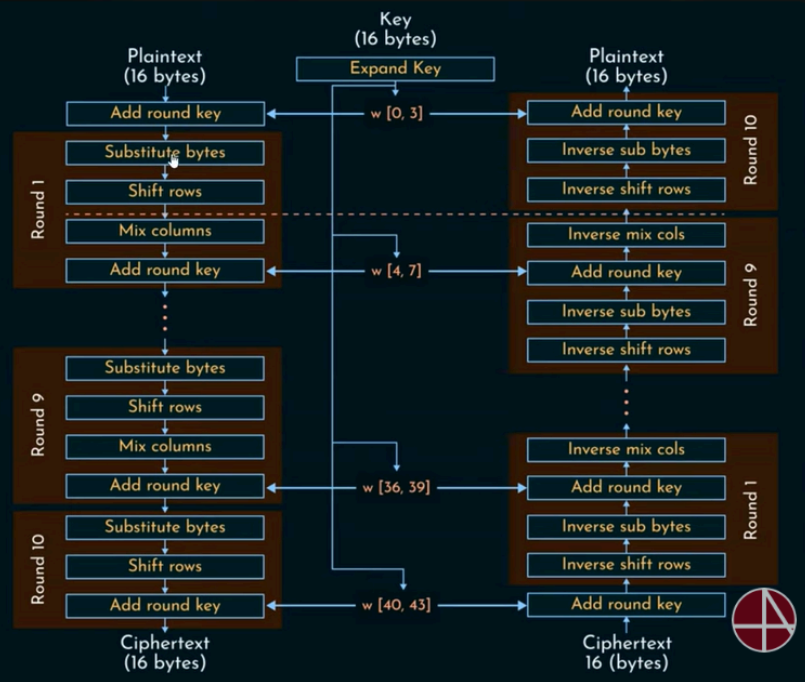

Add Round Key
w_i
w_{i+1}
w_{i+2}
w_{i+3}
=

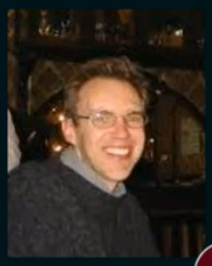
AES Encryption and Decryption



AES

- Rijndael cipher.
- Rijndael was selected as the AES in Oct-2000.
- Designed by Vincent Rijmen and Joan Daemen in Belgium.
- Simplicity.
- 128/192/256 bit keys, 128 bits data.

V. Rijmen



J. Daemen

AES Security

- AES was designed after DES.
- Most of the known attacks on DES were already tested on AES.
- Brute-Force Attack.
- Statistical Attacks.
- Differential and Linear Attacks.

AES Implementation Aspects

- Simple Algorithms.
- Resistant against known attacks.
- Code compactness on many CPUs.
- Cheap processors and minimum amount of memory.
- Very efficient.
- Implementation of AES.

AES Example

https://www.cryptool.org/en/cto/aes-step-by-step